XPath for Dictionary Nerds

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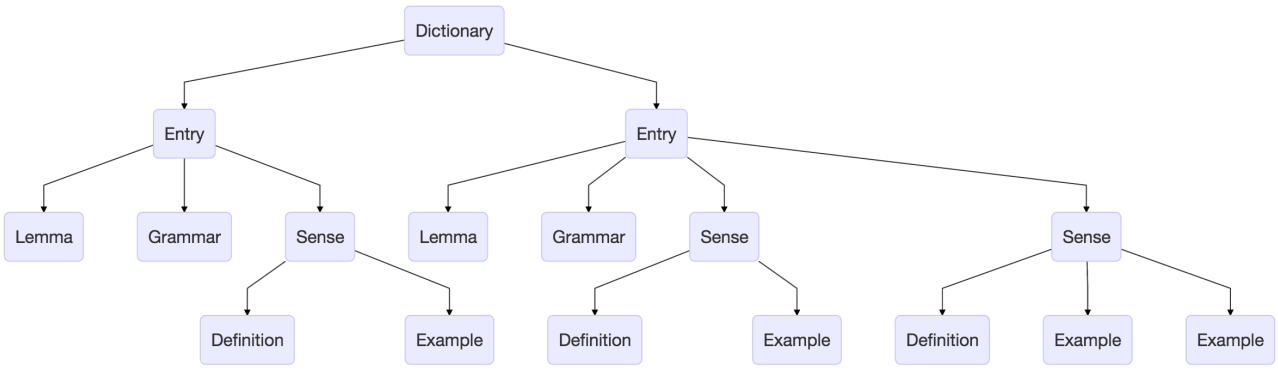
Introduction

What is XPath?

XPath (XML Path Language) is a standard query language for selecting nodes from XML documents.

In this tutorial, you will learn how to write XPath expressions in order to navigate around our XML-encoded dictionaries and select only those bits of data that you are interested in.



Dictionary as a tree structure

Prerequisites

You should already be familiar with types of nodes in XML:

- **element**
- **attribute**
- **text**
- **namespace**
- **processing-instruction**
- **comment**
- **document**

You should already be familiar with the fundamentals of the XML tree structure:

- The **root** element forms the basis of the XML tree and all other element nodes, attribute nodes and text nodes reach out like branches and leaves from this topmost element
- Moreover, various relationships between elements exist. In the **child-parent relationship** one element (the child) is nested inside another element (the parent). In the following example, the element `<lemma>` is nested in the element `<entry>`. Consequently, `<lemma>` is the child of `<entry>` and the parent of `<lemma>`:

```
<entry>
  <lemma>lexicographer</lemma>
</entry>
```

- A **sibling** relationship means that elements (the siblings) have the same parent element. For instance, in the following example, the elements `<lemma>`, `<grammar>` and `<sense>` have the same parent element and are hence siblings to each other:

```
<entry>
  <lemma>lexicographer</lemma>
  <grammar>noun</grammar>
  <sense>
    <definition>A harmless drudge.</definition>
    <example>Some lexicographers are mad!</example>
  </sense>
</entry>
```

- `<definition>` is a child element of `<sense>` and a sibling of `<example>` etc.

The root element, forms the basis of the XML tree and all other element nodes, attribute nodes and text nodes reach out like braches and leaves.

Another language? Why, oh why?

You may wonder why you need to learn yet another language to query your dictionary data. XML is, after all, a text format. You can open an XML-encoded dictionary in any text editor and search for strings in it using your editor's basic search functions.

The trouble with plain-text searches on XML data is that they are not *context-aware*. In a plain-text search, all strings are considered equal and the edtior will return all the hits containing the search string, regardless of its position in the dictionary hierarchy.

This can be ok for quick-and-dirty searches, but it can also produce a lot of noise, if we are looking for something really specific.

Say you have a large, XML-encoded dictionary and you are interested in:

- finding all the entries whose definition starts with or contains a particular word;
- extracting all the entries that have a particular translation equivalent in the target

language;
- exploring all the polysemous entries in a dictionary;

in all of the above cases, succinct XPath expressions will help you get to the specific data that fits your search criteria in a way that plain-text search could never do.

In addition to being useful for studying dictionaries and extracting data from them, XPath is essential to know if you're planning to use XSLT - a language for *transforming* XML documents. XSLT is applied to XML documents when we want to change them from one format to another (for instance, XML to HTML) or when we want to change something across dictionary (for instance, changing all `entry` elements to `entryFree` etc.)

What do I need to work with XPath?

In order to work with XPath, you will need:

- XML structured data
- an XPath-aware editor

XPath expressions are applied to XML data. So in order to query your dictionaries and get interesting results out of them, you have to have them encoded in XML. And you have to use an editor that lets you work with XPath.

XPath can't magically produce results that are not based on the actual structure and actual content of your dictionary. The usefulness of XPath searches is directly proportionate to the granularity at which you encoded your dictionary data: the more markup you have, the more interesting your searches can get.

To help you complete this tutorial, we have prepared a file which contains all the dictionary examples from the TEI Dictionary Chapter plus some.

Before proceeding, make sure to:

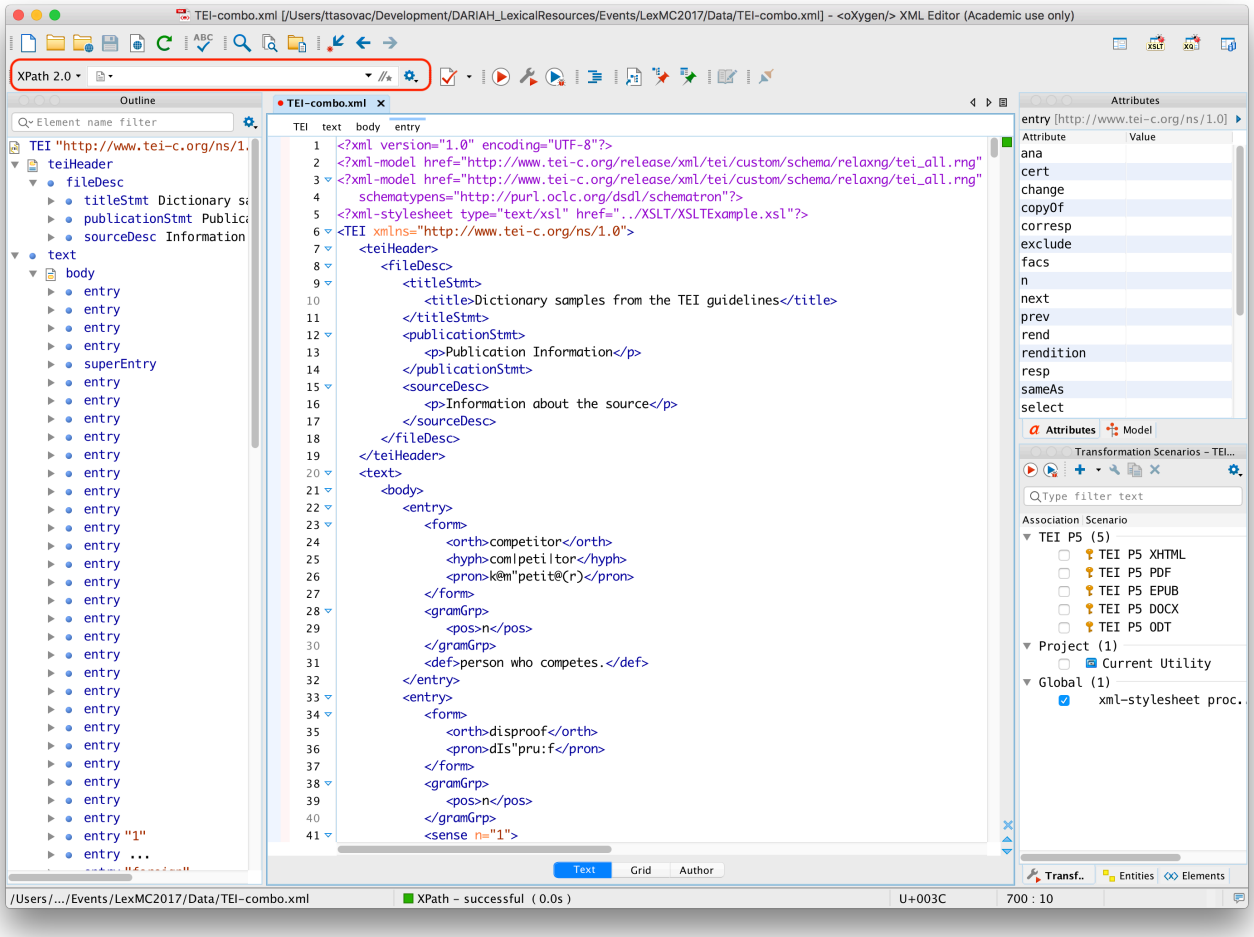
1. download XXXXXX
2. have oXygen XML Editor running on your computer

XPath in oXygen

Before learning the basics of XPath, let's make sure we know how to use oXygen for making XPath queries.

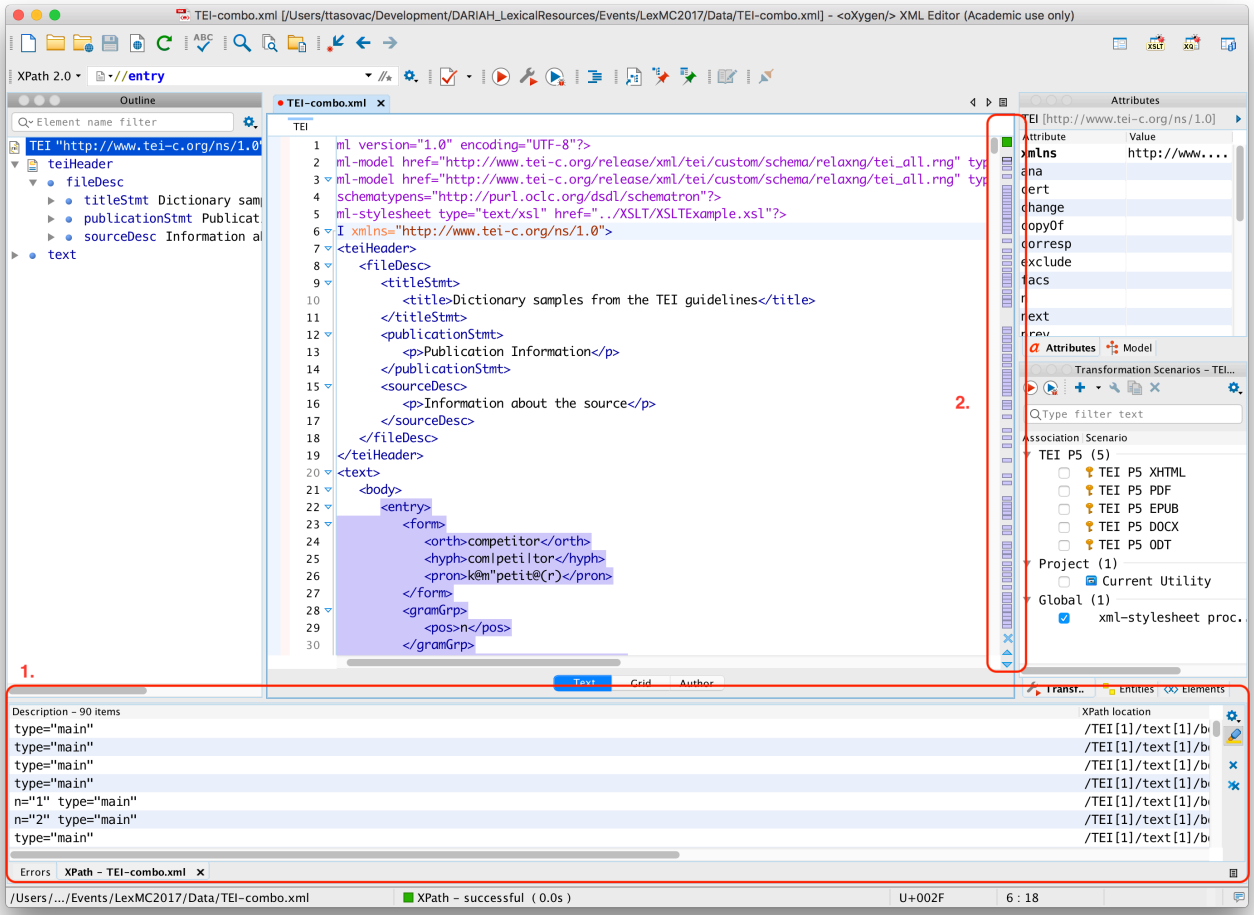
XPath Input Field

Open the downloaded file in oXygen and look for the XPath input field in the upper left corner of the window.



Now, type `//entry` into the XPath input field and press return on your keyboard.

You should be seeing something like this:



1. In the lower part of the oXygen window, you will see the beginning of a list containing all the results that correspond to your query. Clicking on individual rows will select the corresponding result (in this case a dictionary entry) in the main window. *Try it yourself.*
2. On the right-hand side of the main window, you will also see a navigation bar containing visual clues (purple rectangles), each of which represents one match of your XPath query. *Try clicking on different rectangles to see what happens.*

XPath Builder

If you need to write complex XPath expression, the XPath input field will probably be too small. Not seeing the beginning or the end of the XPath expression can be a pain.

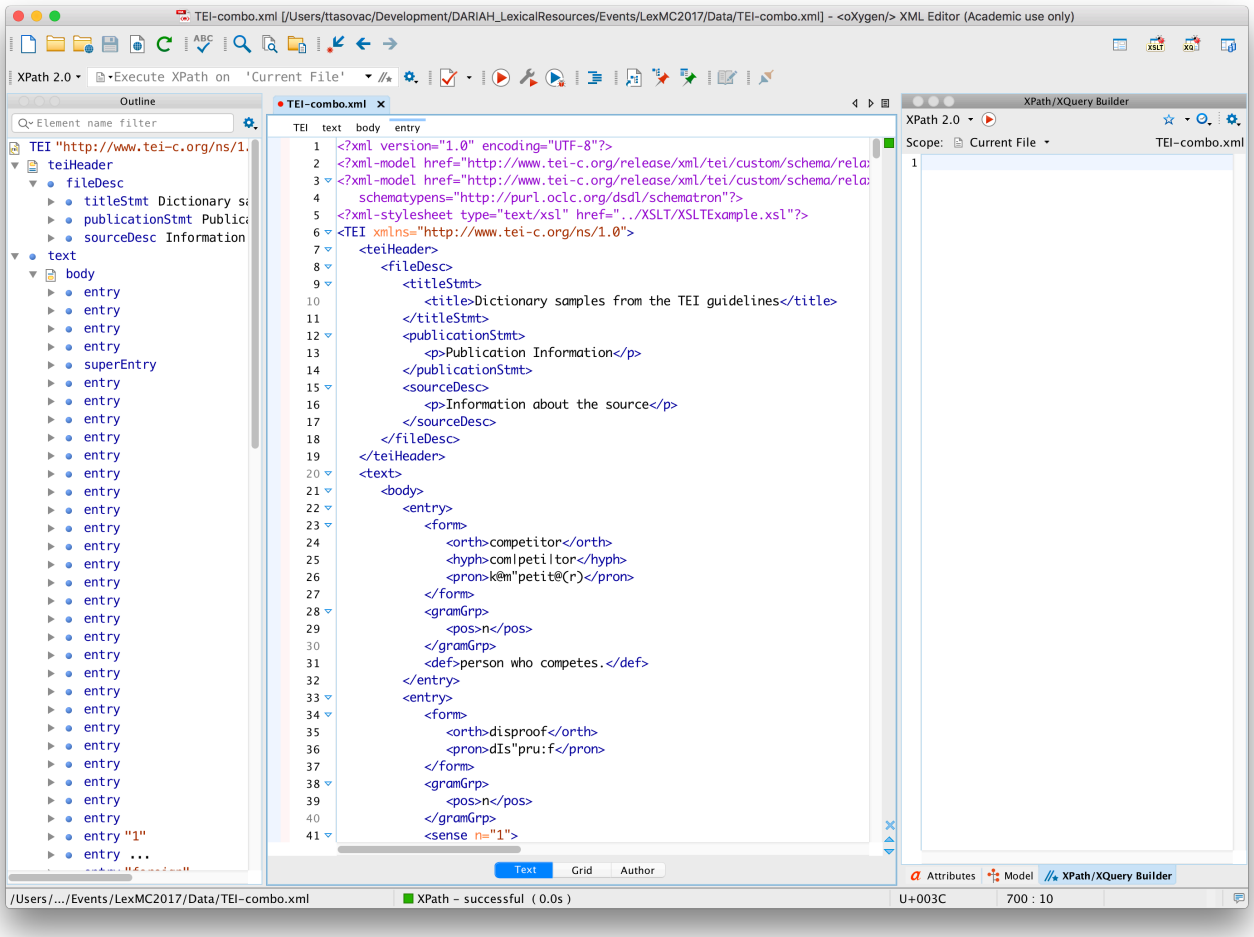
oXygen also offers an XPath/XQuery Builder -- a separate window pane where you can write longer expressions.

Launching the XPath Builder

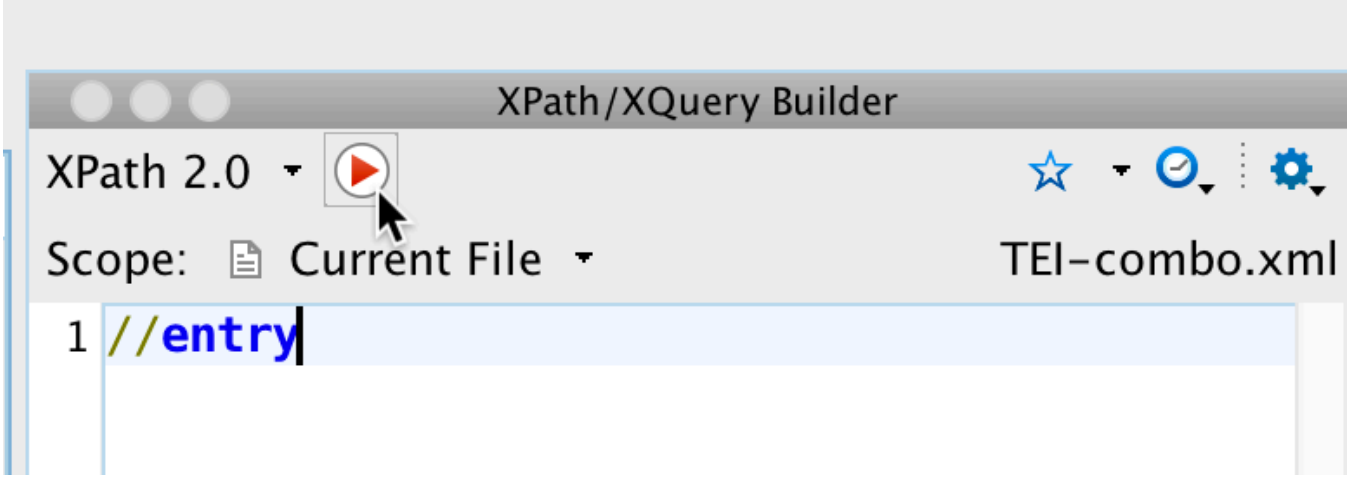
To launch the XPath Builder:

1. go to the main menu and select Window > Show View > XPath/XQuery Builder; or
2. click the Switch to XPath Builder view button which looks like this `//★` and is positioned in the right-hand corner of the XPath input.

Once you launch the XPath Builder View, you should be seeing something like this:



If your screen doesn't look exactly like this, feel free to close some of the smaller window panes, since you won't be needing them. You should probably leave the Outline pane (on the left-hand side as shown above) so that you can easily study the structure of your XML document.



Executing XPath from the Builder

To apply an XPath query from the XPath/XQuery Builder, it is not enough to press `return` as was the case with the XPath Input Field. Because the XPath/XQuery Builder is a multi-line text area. Pressing `return` will simply add a new line to the builder.

To execute an XPath from the XPath/XQuery Builder, you have two options:

1. Click on the small red "play" icon inside the Builder area; or
2. Press `⌘-return` (Mac) or `ctrl-return` (Windows).

TODO: check if ctrl is the META character on Windows.

XPath Expressions

XPath uses so-called *path expressions* to select nodes in a tree by means of a series of steps.

Each step is defined in terms of:

1. An *axis*, which describes the relationship to be followed in the tree (for instance: selecting child nodes, ancestor nodes, attributes etc.)
2. A *node test* which defines what kind of nodes are required
3. Zero or more *predicates* which provide the ability to filter the nodes according to various selection criteria.

You will get to know all of these as we go through various examples.

Examples

In the following examples, we'll be working with the file you downloaded earlier on. Before we start inspect the file so that you become familiar with its structure.

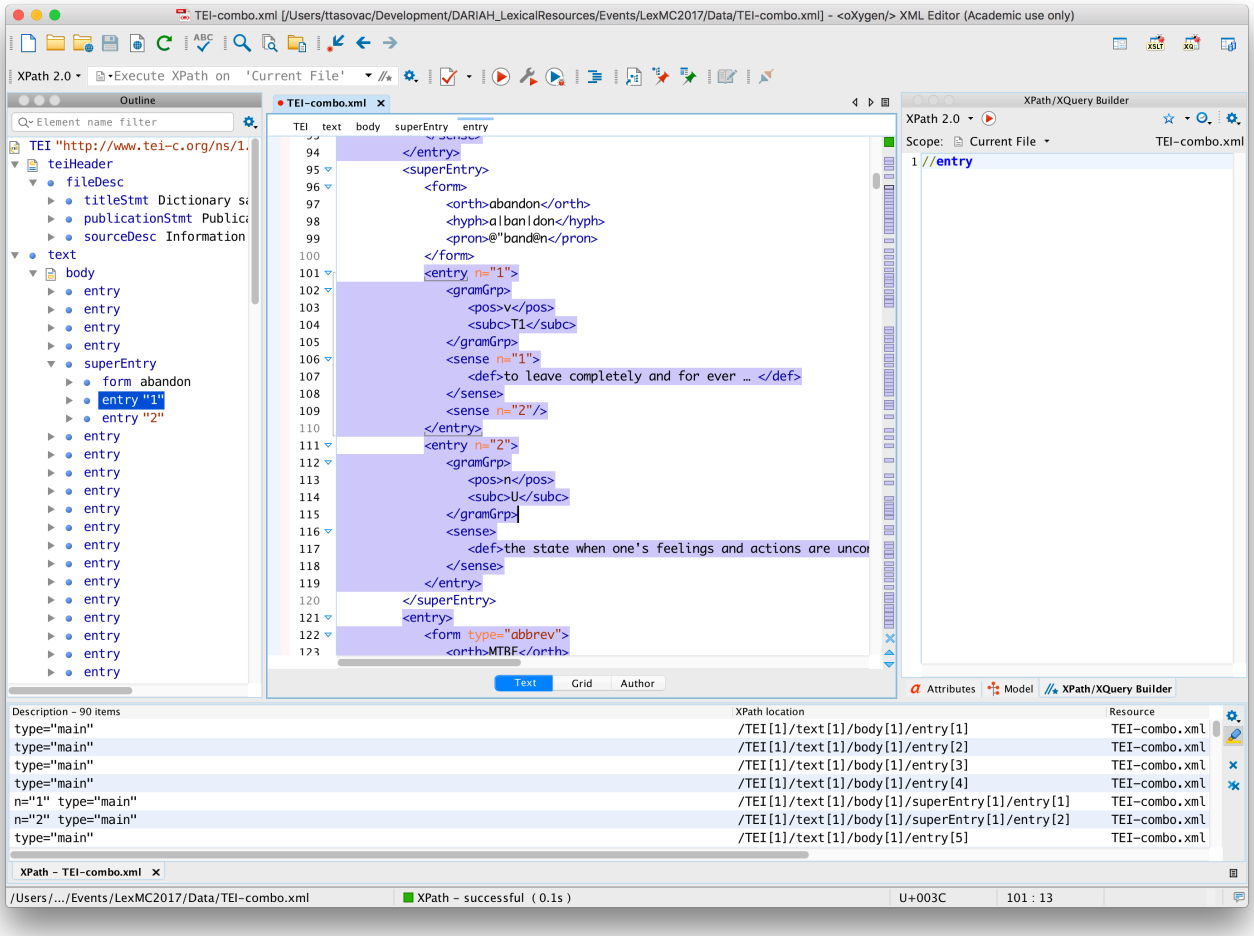
Selecting nodes

Expression	Description
nodename	Selects all nodes with the name "*nodename*"
/	Selects from the root node
//	Selects nodes in the document from the current node that match the selection no matter where they are
.	Selects the current node
..	Selects the parent of the current node
@	Selects attributes

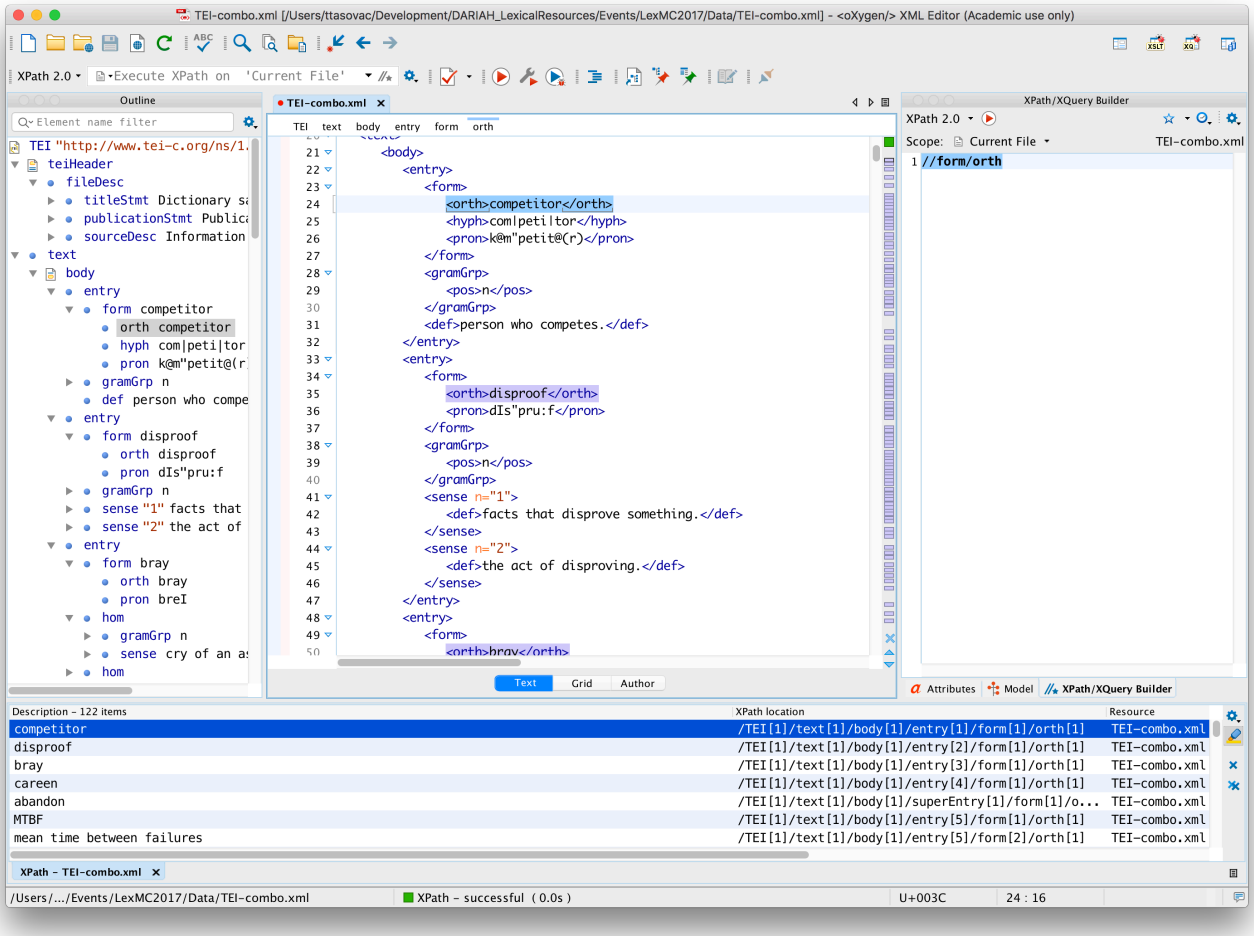
What does that mean concretely when applied to our dictionary file? Try all of the following in the XPath Builder:

Expression	Selects
`/`	the entire document node
`/TEI`	`<TEI>` which is the root node
`/entry`	nothing because `<entry>` is no root node
`//entry`	all entries, no matter where they are

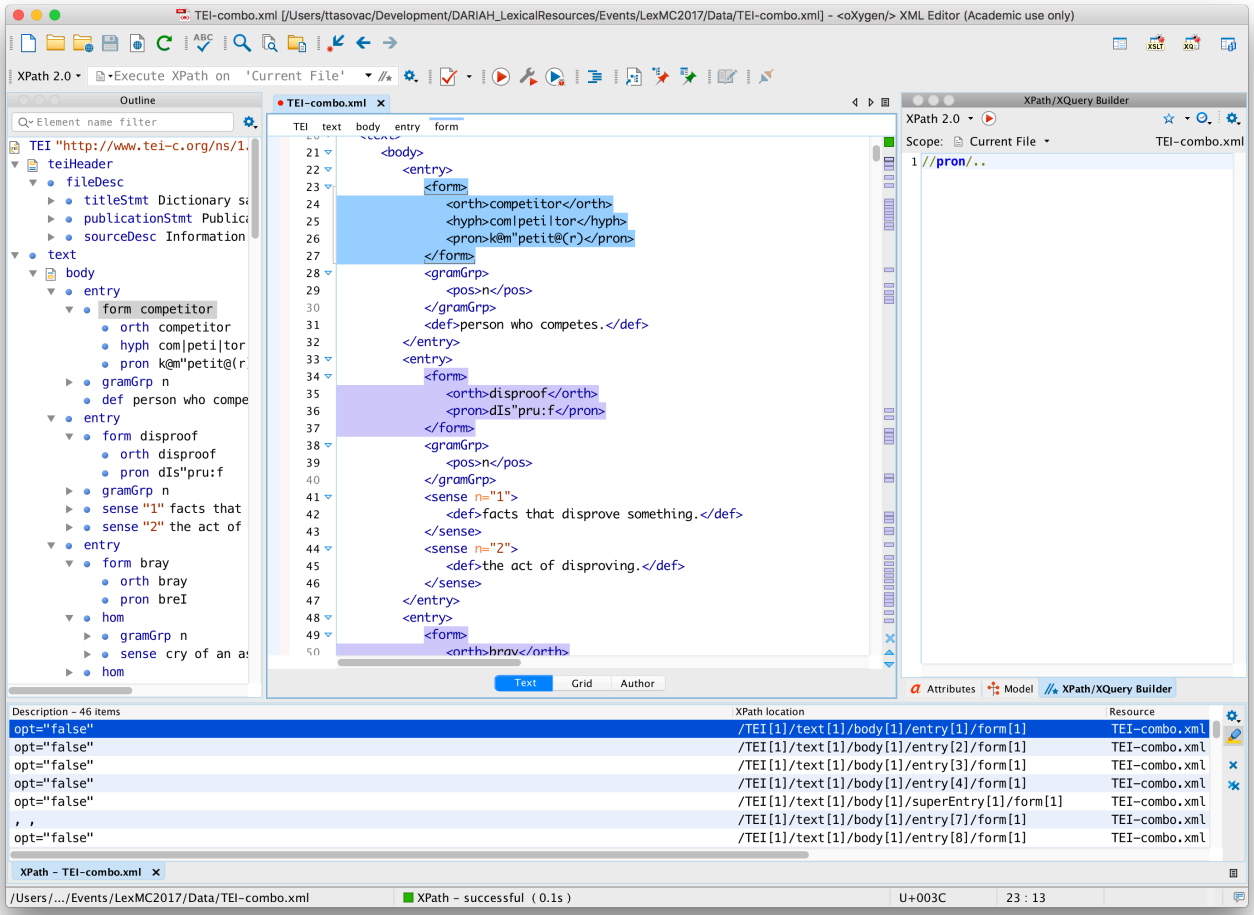
Double-slash is your friend. `//entry` will select all entry nodes no matter where in the dictionary hierarchy they are. As you can see in the document outline pane, most entries in this document are children of `/body` but some are also children of `superEntry`.



Expression	Selects
`//form/orth`	all orth nodes that are children of form



Expression	Selects
`//pron`	all pron nodes no matter where they area
`//pron/..`	parents of all pron elements no matter where they are



Expression	Selects
`@type`	all type attributes, no matter where

Selecting predicates

Predicates are your friends. They are used for selecting specific nodes or nodes that contain specific values.

Predicates are always written in *square brackets*.

Expression	Selects
`//body/entry[1]`	first entry
`//body/entry[last()]`	last entry

Expression	Selects
`//body/entry[last()-1]`	penultimate entry
`//body/entry[position() < 4]`	first three entries
`//cit[@type]`	all cit nodes with type attribute
`//cit[not(@type)]`	all cit nodes without type attribute
`//cit[@type='translation']`	all cit nodes of type translation
`//form[orth="competitor"]`	all forms whose orth = competitor

Now, as you can see, it's easy to select a node such as `form` whose child (`orth`) is of a particular value. But what if you want to select the entire `entry` whose orthographic form is of a particular value? Let's take this in three steps:

Expression	Selects
`//entry`	all entries
`//entry[.//orth]`	all entries that contain orth
`//entry[.//orth="competitor"]`	all entries whose orth="competitor"

As you noticed in `//form[orth="competitor"]` , the first node that you put in the square brackets is always the child of the node before the square brackets. `//entry[orth="competitor"]` would return no results from our document because there is no `entry` that has `orth` as its child: `orth` is the child of `form` and `form` is the child of `entry` , which makes `orth` the descendant of `entry` .

That's why we had to do something else: in `//entry[.//orth="competitor"]` , the dot inside the square brackets represent the "current node", i.e. the child of entry, without specifically naming it. It is followed by double slashes to indicate that we are looking for orth *anywhere* down the tree starting from the current node.

Of course, since orth is the child of form, we could have also written `//entry[form/orth="competitor"]` and the result would have been the same.

Exercise

Write XPath expressions to select:

1. all inflected forms in the dictionary file
2. all entries containing translation into French
3. all entries that contain etymological (`etym`) information
4. all senses that come with usage (`usg`) information
5. all entries with pronunciation (`pron`) information

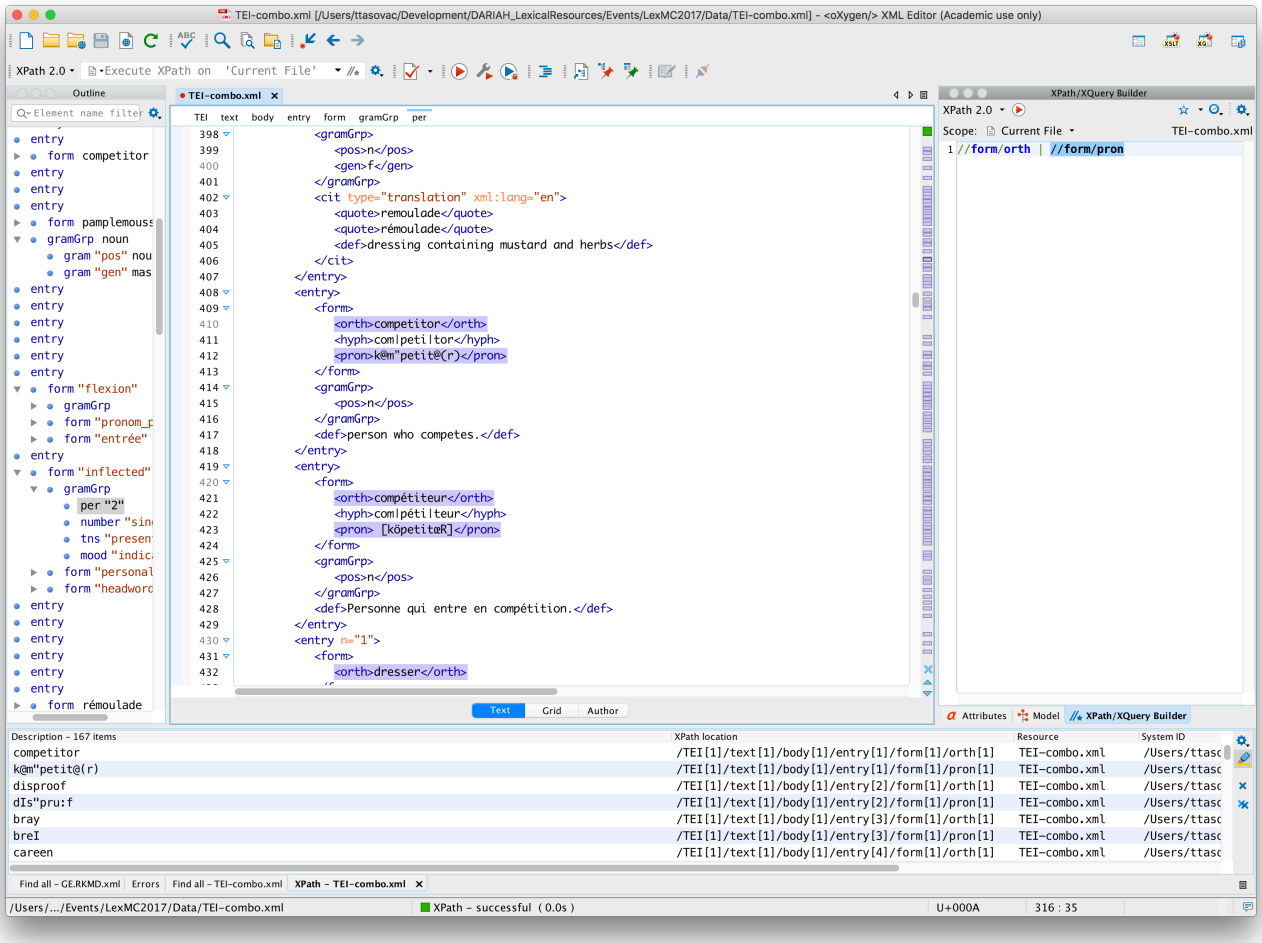
Selecting unknown nodes

Wildcard	Matches
`*`	any element node
`@*`	any attribute node
`node()`	any node (including text nodes)

Selecting more than one path

To select more than one path, we use the or operator (`|`). For instance:

Expression	Selects
`//form/orth`	selects all orths
`//form/pron`	selects all prons
`//form/orths	//form/pron`	selects all orths and all prons



XPath Axes

Remember, how we said that `//entry[.//orth="competitor"]` would select all the `orth` nodes with value competitor that are descendants of entry, no matter where entry appears in the document?

XPath offers numerous ways of selecting axes, i.e. node sets that are in relation to the current node. A different, more explicit, way of writing the above expression would be: `//entry[descendant::orth="competitor"]`. Note the `::` which separates the axis name (`descendant`) from the node name (`orth`).

AxisName	Result
ancestor	Selects all ancestors (parent, grandparent, etc.) of the current node

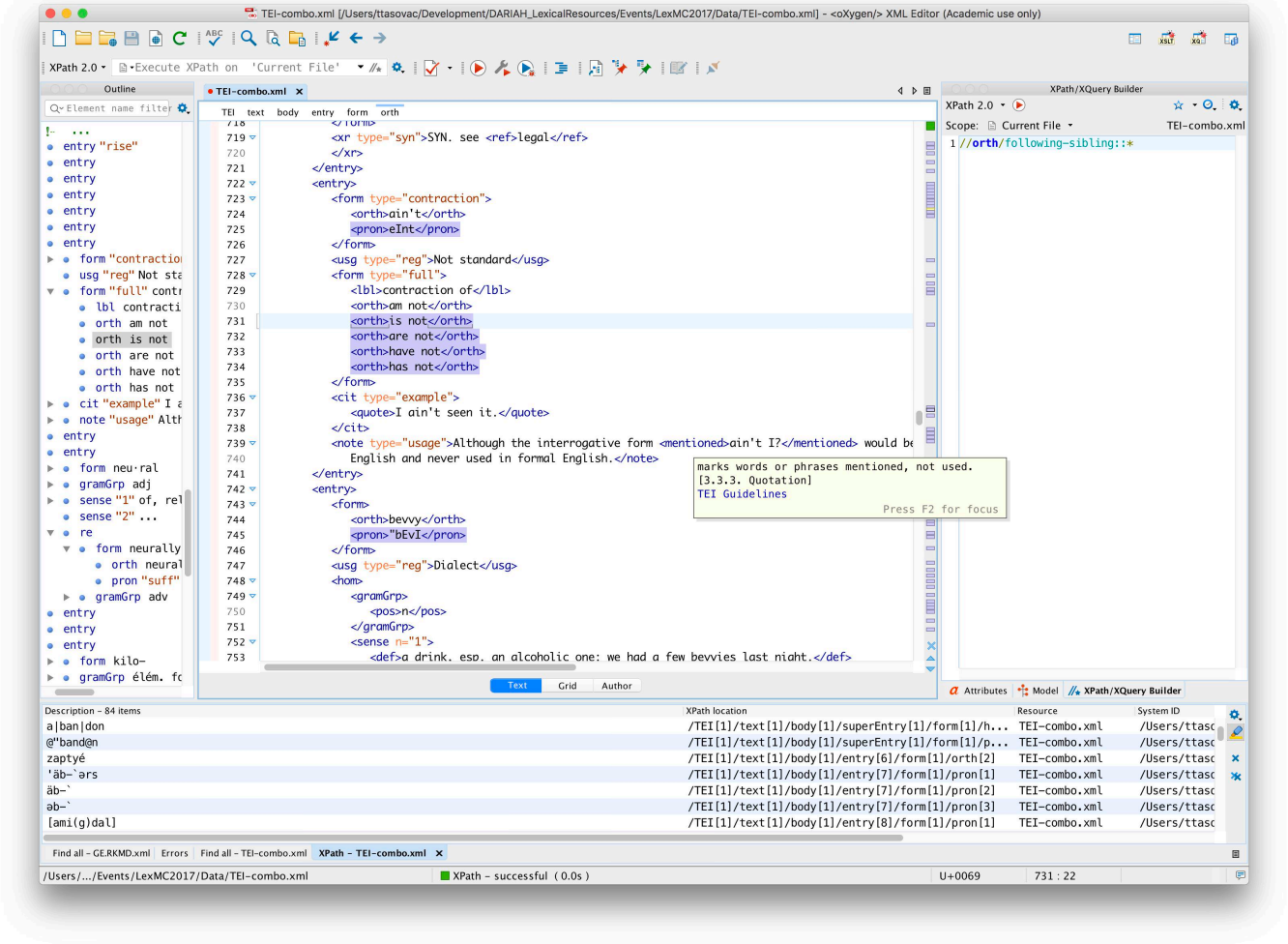
ancestor-or-self	Selects all ancestors (parent, grandparent, etc.) of the current node and the current node itself
attribute	Selects all attributes of the current node
child	Selects all children of the current node
descendant	Selects all descendants (children, grandchildren, etc.) of the current node
descendant-or-self	Selects all descendants (children, grandchildren, etc.) of the current node and the current node itself
following	Selects everything in the document after the closing tag of the current node
following-sibling	Selects all siblings after the current node
namespace	Selects all namespace nodes of the current node
parent	Selects the parent of the current node
preceding	Selects all nodes that appear before the current node in the document, except ancestors, attribute nodes and namespace nodes
preceding-sibling	Selects all siblings before the current node
self	Selects the current node

So, what does mean in practice? Let's see one example in three individual steps:

Expression	Selects
`//orth`	all orths
`//orth/following-sibling::pron`	all prons that follow orths
`//orth/following-sibling::pron[1]`	all the first prons that follow orths
`//orth/following-sibling::*`	all elements that follow orth

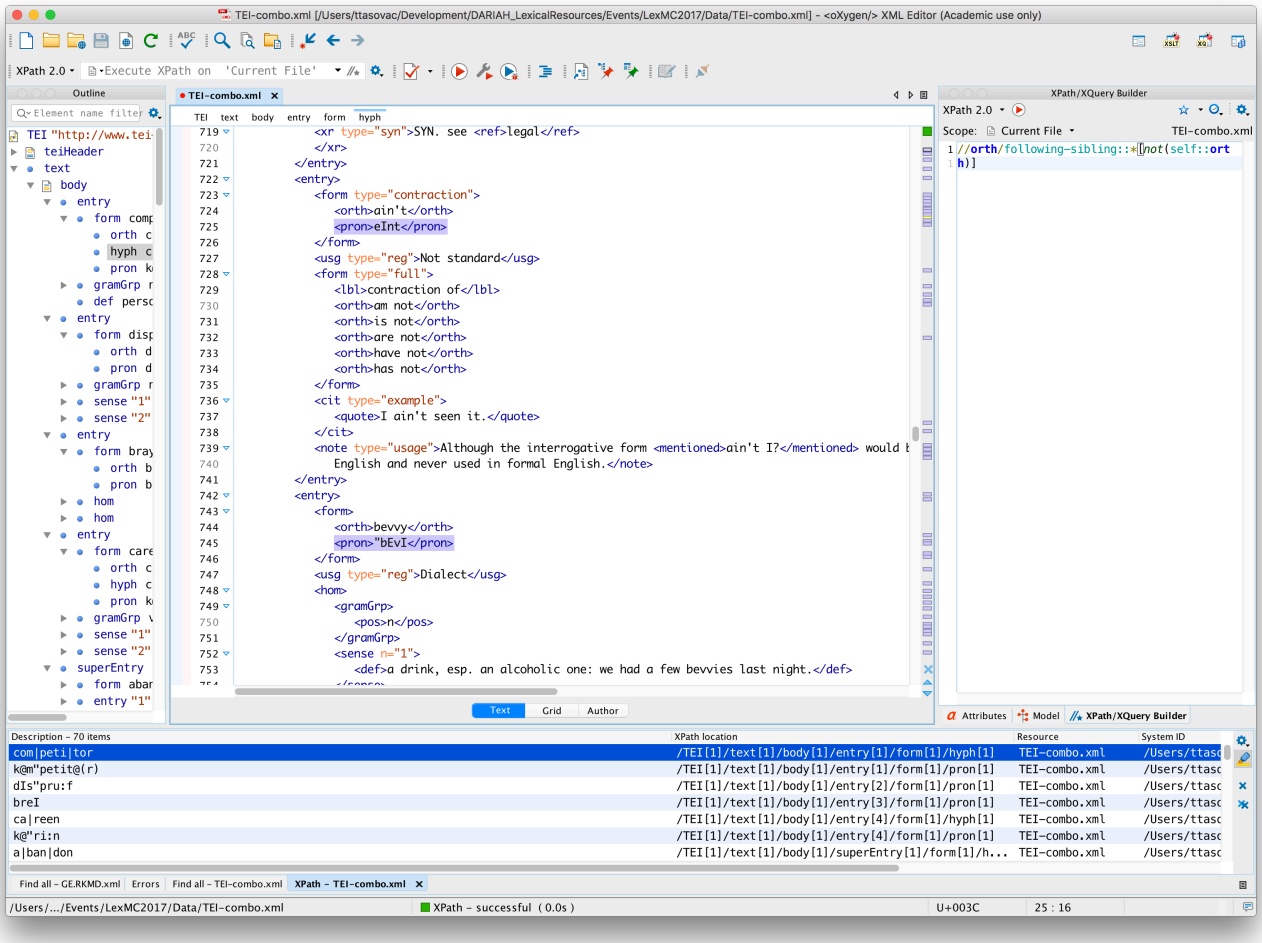
Now, the interesting thing about the last expression is that it will also select this particular

case:



As we learned above, `*` selects any element node, and if you look for `//orth/following-sibling::*` you will also match orths that follow orth. If this is not what you want, you could rewrite the expression in such a way to select any element node which follows orth but which is itself *not* orth. That would look like this:

Expressions	Selects
`//orth/following-sibling::*[not(self::orth)]`	non-orth elements that follow orth



Exercise

1. We haven't specifically covered this, but let's see if we can figure out the following expression: `//entry[count(sense)>1]`
2. What is the difference between `//entry[count(sense)>1]` and `//entry[count(.//sense)>1]`?
3. What is the difference between `//entry[count(child::sense)>1]` and `//entry[count(descendant::sense)>1]`?